

**REMARKS**

Claims 1, 2, 5-8, 12, 14, 20-21, 25, and 32 are pending, and claims 4, 9, 15-19, 22-24, 26-27, and 30-31 have been withdrawn without prejudice and while preserving applicant's right to rejoin upon allowance of a generic claim. Favorable re-consideration is requested.

Claim 1 has been amended as supported by the specification, e.g., the antenna is a resonant antenna (page 3, line 14) which generates a sinusoidal distribution of current (page 3, line 15), and such a distribution generates helicon waves that efficiently produces high-density plasma (see the specification page 1, lines 9-10 and page 6, line 13). No new matter has been added.

At the outset, applicant thanks the Examiner for the Advisory Action of February 22, 2011, that withdrew the formalistic rejections. With respect to the prior art rejections, applicant has amended the claims to even further distinguish its invention from anything disclosed or suggested by the prior art. In this regard, the claimed structure is very different than anything disclosed in the primary reference (Bennett), the secondary reference (Campbell), and any other reference either alone or in combination.

The following prior art rejections were asserted in the most recent Office Action:

1. On pages 3-5 of the Action, claims 1-2, 5, 8, 12, 21, 25, and 32 stand rejected under 35 U.S.C. 103(a) as allegedly being obvious over Bennett (U.S. Patent 6,495,963) in view of Campbell (U.S. Patent 4,990,229) and Kwon et al (U.S. 2002/0189763) or Howald (U.S. Patent 6,441,555).
2. On page 6 of the Action, claims 6 and 20 stand rejected under 35 U.S.C. 103(a) as allegedly being obvious over Bennett in view of Campbell and Kwon or Howald and further in view of Saito (U.S. Patent 5,728,253) or Durr (U.S. Patent 5,180,949).
3. On pages 6-7 of the Action, claim 7 stands rejected under 35 U.S.C. 103(a) as allegedly being obvious over Bennett in view of Campbell and Kwon or Howald and further in view of Collins (U.S. Patent 6,024,826).

4. On page 8 of the Detailed Action, claim 14 stands rejected under 35 U.S.C. 103(a) as allegedly being obvious over Bennett in view of Campbell and Kwon or Howald and further in view of Hashimoto (U.S. Patent 6,096,232) or Okumura (U.S. Patent 5,888,413) or Yoshida (U.S. Patent 5,690,781).

As stated previously, applicant traverses the prior art rejections for at least the following facts and reasons and those stated in applicant's Amendment filed on August 16, 2010.

Bennett is the primary reference cited in each rejection. Figure 12 of Bennett shows several loop elements (13a) which form one part of the entire loop, but the loop elements are not spaced "along" the common longitudinal axis and are not interconnected by axial conductive elements from each other. These are major defects in the primary reference.

As stated in applicant's previous responses, the closed top loop and bottom loop of Figure 12 of Bennett are NOT part of the antenna because they do not generate any magnetic field. These facts are indisputable.

With respect to portions 14a and 14b of Bennett that were cited by the Examiner, according to those skilled in the art and standard science, these portions are not part of the antenna because they do not generate a magnetic field (because 14a and 14b are close to each other). There is no scientific support to say otherwise.

Regarding the patentable weight of the generation of plasma by helicon waves, applicant notes that claim 1 requires an antenna structured as a resonant antenna that generates plasma by helicon waves. Here, the generation of helicon waves is caused by the structural limitations of the antenna: the antenna is a resonant antenna (page 3, line 14) which generates a sinusoidal distribution of current (page 3, line 15), and such a distribution generates helicon waves that efficiently produces high-density plasma (see the specification page 1, lines 9-10 and page 6, line 13).

Applicant respectfully notes that the prior art rejection of independent claim 1 fails to show a prima facie case of obviousness for at least the following reasons.

**A. BENNETT - USP 6,495,963**

Bennett fails to disclose the following key features of claim 1:

1. “*magnetic field generators arranged around the antenna*”

Bennett does not disclose an apparatus comprising magnetic field generators arranged around the antenna.

2. “*said antenna comprises at least two conductive loop elements*”

Applicant notes that an antenna is made of electric conductors that generate an electric or magnetic field, and that the antenna is supplied by supply conductors. The supply conductors do not generate any electric or magnetic field; thus, they are not part of the antenna.

In contrast to the claimed invention, Bennett discloses, in Figures 9-13 and their descriptions, an antenna comprising only one conductive loop, namely, the loop (coil 13) constituted by a plurality of coil portions (13a). The coil portions 13a constitute a single coil - see column 3, lines 56, 57. The electric current flowing in any part other than the segments of coil 13a is balanced by a current flowing in an opposite sense in an adjacent part, so that they do not generate any electric or magnetic field - see column 1, lines 27-30. As a result, the parts other than the segments 13a are supply conductors, and are not part of the antenna:

- e.g., in Figure 9, the leads 14a and 14b are “*input lead and output lead*” (column 4, line 14), the lines 16 are “*feed lines*” (column 4, line 15),

- in Figures 11 and 12, the rings 12a and 12b are “*connecting rings*” (see column 5, lines 8-12), and are not parts of the antenna: opposite currents will flow in the rings, the currents are balanced, and the rings do not generate any electric or magnetic field.

If we consider that Bennett discloses several conductive elements 13a, then each of those elements 13a is not a “*loop*,” and does not surround the common longitudinal axis.

Accordingly, Bennett fails to disclose the claimed “*said antenna comprises at least two conductive loop elements.*”

3. “*spaced along a common longitudinal axis*”

In Bennett, there is only one loop element 13. Accordingly, the feature “*spaced along*” is not disclosed in Bennett.

4. “*a pair of axial conductive elements electrically interconnecting said conductive loop elements*”

In Bennett, there is only one loop element in the antenna. Accordingly, the feature “*interconnecting*” is not disclosed in Bennett. In this regard, the conductive elements (14a, 14b) are not “*axial conductive elements*” in Figure 9 of Bennett. They are radial elements. In addition, the conductive elements 14a and 14b in Figures 11 and 12 are feeding elements which interconnect the only one loop element of the antenna with feeding rings 12a and 12b which are not part of the antenna. Consequently, those conductive elements do not electrically interconnect several loop elements of the antenna.

5. *each loop element including at least one capacitor*

Bennett fails to disclose this feature because the capacitors (18) are present in relation with only one loop element. Furthermore, Bennett fails to disclose capacitors which are inside the conductive loop elements, and which are therefore part of the antenna. In Bennett, the capacitors are between two supply conductors, namely, 14a, 14b, and are not between the segments 13a of the antenna.

6. *The technical effects, and “the antenna is structured as a resonant antenna that generates plasma by helicon waves”*

As demonstrated above, there are many key differences between the features of the antenna of Bennett and the features of the antenna of claim 1. These differences are important because they result in very different effects, namely, very different generated electric fields.

In the present invention, as stated in claim 1, by the feature “*for plasma generation by helicon waves*,” the sinusoidal distribution of current amplitude within the antenna legs (the axial conductive elements) results in transverse fields that generate helicon waves in the area inside the antenna. Claim 1 requires that the antenna is structured as a resonant antenna that generates plasma by helicon waves.

In contrast, in Bennett, the generated fields are not transverse, but are parallel to the longitudinal axis, as is always the case in a coil. See Figure 8. Significantly, this Bennett structure will not generate helicon waves, and there is no incentive to create a structure to do so.

All of the foregoing deficiencies of Bennett are not overcome by the secondary references. Nor would a person skilled in the art use Bennett’s apparatus and reasonably modify it (or destroy it) to arrive at the claimed invention. Not even with improper hindsight would a person skilled in the art do so.

### **B. CAMPBELL - USP 4,990,229**

Campbell does teach magnetic fields generators (16, 17) arranged around the antenna (15). See column 7 lines 41-44. However, Campbell fails to disclose the important claimed feature of “a pair of axial conductive elements electrically interconnecting said conductive loop elements.” For example,

- In Figure 4, the loop elements (1, 2) are connected by only one axial conductive element (5). The conductive elements (6) are feeding elements which each connect a loop element (1 or 2) to the matching box (9) which supplies the antenna.
- In Figure 5, there is only one axial conductive element (12) which connects the loop elements. The other conductive elements (13) each connect a loop element to the matching box.

Campbell fails to disclose capacitors in the conductive loop elements. Accordingly, when trying to combine Bennett and Campbell, the feature of “*a pair of axial conductive elements electrically interconnecting said conductive loop elements*” is still missing.

### **C. KWON - US Pat Pub 2002/0189763 A1**

In Kwon, the antenna is planar. As a result, Kwon fails to disclose the missing feature of any combination of Bennett and Campbell, i.e., “*a pair of axial conductive elements electrically interconnecting said conductive loop elements.*”

### **D. HOWALD - USP 6,441,555 B1**

Howald discloses a spiral-like coil (see the abstract line 1, see Figure 2) which is planar (see column 5, lines 64-65, column 30, column 11, line 50). Accordingly, Howald fails to disclose the missing feature of a combination of Bennett and Campbell: *“a pair of axial conductive elements electrically interconnecting said conductive loop elements.”*

For at least the foregoing reasons, there is no prima facie case of obviousness of claim 1 – from which all claims depend.

Applicant submits that the application is in condition for allowance, including all pending claims and the withdrawn claims, for which applicant requests rejoinder. A notice to that effect is earnestly solicited.

If the Examiner has any questions concerning this case, the undersigned may be contacted at 703-816-4009.

Respectfully submitted,

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